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KISA in low tech traditional sectors as technology innovation promoters

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1. Introduction

1.1. Theoretical and empirical background of KISA

Tether (2003) has analysed innovation dynamics in services and classified them in three sectors: traditional, systemic and knowledge-based. In this paper we are concerned with the third alternative due to its relevance in the creation and transfer of knowledge and innovation through its support of innovative activities across a wide range of other business fields, as well as its interconnecting role among various clusters (Kuusisto and Meyer, 2003). Knowledge-intensive service activities (KISA) are defined as "*the production and integration of service activities undertaken by firms, in manufacturing or service sectors, in combination with manufactured outputs or as stand-alone services*". KISA can be provided by private enterprises and public sector organizations. Typical examples of KISA include R&D services, management consulting, IT services, human resource management services, legal services, accounting and financing services, and marketing services (OECD, 2006).

The impact of KISA in industry has been dealt with by numerous papers, more from an empirical than an academic approach. The case of high-tech industries has been highlighted by a number of authors (Shan Hu et al, 2006). Others have analysed its impact in the software services (Martinez-Fernández and Miles, 2006; Rajala et al., 2008), or medium tech industries (Albors et al., 2008), tourism services (Collado, 2005), health services (Kivisaari et al., 2004), aquaculture (Aslesen, 2004), mining (Martinez-Fernández, 2005), traditional industries (Ebersberger, 2004) or manufacturing (Lee, 2004). In a previous piece of research we have analysed how the level or influence of KISA, in medium tech industries, is related to innovation, competitive advantages, and economic performance outputs as well as to its customer focus (Albors et al., 2008). The role of KIS in facilitating SME growth, competitiveness and innovation has been pointed out by Haukness and Antonelli (1999).

But KISA need interfirm relationships. In the case of firms such as the ones covered by our research, a firm's relational capabilities are fundamental for achieving competitive advantages and export success. Firms must look beyond their boundaries and tap into distinctive competencies of external actors such as distributors, competitors, suppliers, etc (Mcevily and Marcus, 2005). Moreover, when firms are located in clusters, firm-specific characteristics such as absorption capacity or relational capabilities interact with the cluster resources and have a synergic effect (Hervás and Albors, 2008).

Following this we must consider that linkages with local knowledge institutions constitute key elements for the development of new knowledge by firms. Thus, local entities such as R&D centres or universities can support these tasks (Rosenberg and Nelson, 1994). In addition, empirical evidence shows that proximity between local universities and firms promotes the exchange of ideas (Lindelöf and Löftsen, 2004) and also improves the performance of innovative firms (Hanel and St-Pierre, 2006).

1.2. Empirical context: the citrus value chain

The industry's (citrus sector) position in the global value chain and the firm's upgrading implications (Gereffi et al., 2005) have also been considered as a competitive contribution of KISA (i.e., innovation and marketing). Moreover, some authors (Humphrey and Schmitz, 2002) have analysed the insertion of firms in global value chains and the role of local networking and cluster linkages in their upgrading. In our case, upgrading must be based on reinforcing the local governance of firms by active interfirm cooperation as well as active cooperation with local institutions. Moreover, innovative activities through learning by doing and spreading innovation in the cluster are fundamental for the upgrading process.

The global processes related to the citrus value chain involve production and product development as well as its delivery to final consumers. Value-chain analysis, which includes the whole cycle, provides a tool for mapping the governance drives of the chain and outlines both intra firm organization dynamics and relationships between firms (Kaplinski, 2004). It also needs to address the ways in which poor producers and countries connect with producers and consumers in the global economy.

2. Research objectives and questions

2.1. Objectives

This paper will analyse the role of KISA in low-tech industries linked to agro food processes. It will demonstrate how KISA plays a fundamental role in these activities and contributes, not only to innovation activities of firms, but also to the firm's performance. As input variables, the paper will analyse knowledge service activities (internal and external) as well as other variables which may influence the orientation of KISA such as organisational aspects, strategic management approach, human capital, the education and training of its personnel, the relations with other firms, or with research centres. Output variables such as economic performance, growth and innovation indicators have been also taken into account in the model.

2.2. Problems, questions and development of hypotheses

The problems this paper tries to solve are related to the following questions: are KISA relevant in low-tech industries? Do they have a significant impact on a firm's innovation? Does it make any difference whether KISA are internal or external to the firm? Which KISA are more pertinent for firms? Are firms' organisational aspects critical for the adoption of KISA? How does KISA relate to firms' capabilities? Are KISA contributing to upgrade the firm's position in the value chain? How do the firm's capabilities facilitate KISA's influence?

Table 1 below sums up and defines the relevant hypotheses which the research will try to answer. Figure 1 schematically shows the model proposed here. According to this, KISA (internal and external), undertaken by firms in manufacturing low-tech sectors, in

combination with manufactured outputs or as stand-alone services, contribute to firms' innovative and economic growth and performance. KISA's contribution is however regulated by the firm's absorptive capacity as measured by employee's skills and education.

Table 1. Research hypotheses

Hypothesis		References
H_1	KISA activities have a relative influence on manufacturing firms' innovative activities, irrespectively of their technology orientation.	Albors et al, 2008; Aslesen, 2004; Ebersberger, 2004; Lee, 2004; Miles, 2005; OECD, 2006.
H_2	KISA activities have a relative influence on low-tech firms' growth and economic performance	Albors et al, 2008; Aslesen, 2004; Haataja, 2005; Miles et al, 1995; Windrum, 1999.
H_3	Absorption capacity of firms are a co-adjuvant in KISA influence	Hervas and Albors, 2008; Miles, 2005; Cohen 1990.

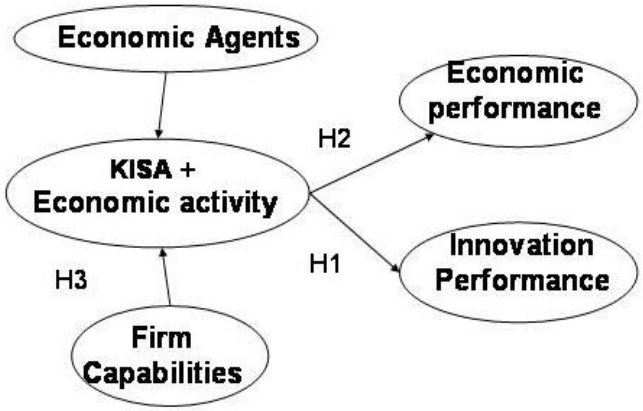

Figure 1. KISA and its influence on firms' performance

3. Methodology and fieldwork

3.1. Fieldwork

During the first half of 2004 a representative sample of citrus packers in La SAFOR region was interviewed as part of regionally supported SME project. 122 firms (84.13%) of a population of 145 agreed to participate in the field work. The contact persons were either firms' general managers or first line managers. The firms filled in the questionnaire and a number of firms (14) were visited personally by the researchers, in order to evaluate the survey more closely. The average size was 64.75 employees while the size distribution is: 7% large firms, 55% medium firms and 38% small firms. The firms had an average operating experience of 30.8 years.

The survey covered a number of questions, some referring to the firm's organizational characteristics such as size, whether the management was carried out by the owner or a hired professional, the percentage of university graduates at the staff, firms' growth measured by employment, R&D and innovative activities (internal or external) and full time staff dedicated, local and external commercial contacts as a measure of the firm's network extension and depth, percentage of temporary staff, number of brands for product

commercialization, marketing external services, grade of innovative equipment such as visual classification, continuous staff training, etc.

3.2. Variables and descriptive results of field work

Following we describe the variables included in the survey, as well as their mean values.

Performance measurement variables

V_1 – PROCINN (0-2). Since product innovation is basically carried out by suppliers (citrus growers), innovation is limited here to the process. 41.1% of the firms have obsolete process technology and equipment (older than five years), 36.1% have state of the art technology and equipment and 22.8% have recent innovative technology and equipment incorporating some high-tech element such as video-classifying systems.

V_2 – PERFORM (1-5). This variable measures the EBIDTA of the firms. Taking the sectorial database profit figures as an average (x=3) and grading this variable from 1 to 5, the sample average was 2.49.

V_3 – GROWTH (0-2). This variable measures the firm's employment variation in the previous 5 years. 14.8% of the firms were stable or had reduced their average workforce, 73.8% had increased their workforce in a range of 1-10% and 11.5% had grown over 10%.

V_4 – EXP (0-4). This indicates the turnover percentage marketed on international markets, the average being 32.5%.

Firm context variables

V_5 – SIZE (continuous). Firm size measured by staff average number. This is a control variable.

V_6 – PROFMANAG (0-1). This variable means whether the management of the firm is carried out of the owner or by professional managers. 70.2% of firms had separate management and ownership.

V_7 – PERMEMPLOY (%) and V_8 – TEMPEMPLOY (%). This reflects the percentage of permanent employees versus that of temporary employees who are hired each season. On average, 34.6% of the workforce in the firms was permanent and 44.1% temporary.

V_9 – EDUCATEMPL (%). This variable represents the staff percentage with mid or higher-level education. 8.32% of the firm's staff had university education.

V_{10} – TRAINING (0-1). This variable represents whether the firm carries out technical training courses in a permanent mode such as selection, waxing, cleaning, operating the equipment, etc. These courses are generally promoted at no cost by public bodies such as local agro food offices. 58.9% of the firms give training for their employees.

V_{11} - YEARS. Years the firm has been operating in the market.

V_{12} – ACCOUNTANCY (0-1). This represents not only standard accountancy activities services but others such as tax reporting, standards and norms and particular legal advice and personnel management such as social security registration and payments. 29.5% of the firms

have outsourced accountancy activities. As has been pointed out by academics (Martinez-Fernández, 2002, 2006; Miles, 2003), accountancy services play a relevant role in organizing knowledge influencing strategy and interconnecting firms using the same accountancy firm.

V_{13} – ISO (0-1). This covers activities associated with certification maintenance which are carried out externally at most firms. 32.8% of the firms have been registered with ISO 9002.

V_{14} – BRAND (0-1). This variable represents whether firms manage their own brands with which they commercialize their products. Brand is a key element in positioning the firm in the value chain. Large firms have strong brands. This branding activity is carried out internally in most cases. 25.6% of the firms market their brands.

V_{15} – MKTG (0-1). This variable is linked to the previous variable. Here we measure if the firms carry out marketing activities in support of their brand, such as designing and printing brochures describing the product specifications or designing and printing product packaging. These activities are normally outsourced to external marketing firms. The reply is positive in 24.6% of the cases.

V_{16} – FIRMAGREEM (0-1). 18% of firms have signed formal agreements with other firms: citrus suppliers or cooperatives, competitors for common campaigns, serving common customers, etc.

V_{17} – INTCONTACT (continuous). As was pointed out, firms' internal networking has been measured by the normal continuous and formal contacts that firms maintain with local firms such as equipment, chemical, or product suppliers, as well as customers, etc. All sample firms maintain local contacts, while the average number was 98.47. This variable can be a measure of the cluster effect of the group.

V_{18} – EXTCONTACT (continuous). This variable refers to firms' external networking and has been measured by the formal contacts which firms have with external firms (at national and international level) such as equipment manufacturers or distribution customers. Sample firms maintain external contacts and the average was 25.6.

V_{19} - R&D&I (0-1). The variable relates to R&D and innovative activities in the last three years.

V_{20} - R&DINT (0-1). This variable represents whether the R&D and innovative activities are internal to the firm.

V_{21} - R&D&I EMPLOY (0-1). This measures the intensity of R&D activities and innovative activities when the respondent could identify at least one employee carrying out R&D& and innovative activities.

V_{22} - R&D&IAGREEM (0-1). This variable measures whether the firm has R&D and innovation agreements with RTC organizations. The results were as follows: 21.3% of firms have carried out some innovative activity in the last three years; 16.4% of firms could name an employee carrying out R&D or innovative activities; finally, 8.2% of firms had some agreement with a local research institute. It can be concluded that this is, in general, an internal KISA externally supported in 40% of the cases.

V_{23} – ASSOC (0-1). This variable represented whether the firms were active members of an industry association. Most of them are partners in a cooperative which manages a refrigerated port warehouse. 45.9% of the firms belonged to an industry association.

3.3. Multivariate analysis. Empirical results and discussion.

In order to perform a multivariate analysis, and as a first measure, a factor analysis was carried out in order to select and identify independent variables which were significant. It concluded with the following results. A rotation was obtained after 8 iterations and the factor analysis detected four components which could explain 85.2% of sample variance (Table 2). These components were associated to variables in the following way: C_1= f (V_{12}, V_{14}; V_{15}; V_{19}; V_{20}; V_{22}); C_2 = f (V_5; V_9; V_7); C_3 = f (V_{17}; V_{18}); and C_4 = f (V_{11}).

- C_1 is associated with KISA such as brand development and marketing management, agreements, accountancy, R&D variables and R&D agreements.
- C_2 is associated with firms' size, percentage of permanent staff, and education profile of staff. Except for size this component is a measure of the firm's absorption capacity.
- C_3 is associated with the intensity of the contact network of the firm
- Finally, C_4 represents the experience of the firm represented by its operating years.

Table 2. Rotated component matrix

	Component			
	1	2	3	4
BRAND	0.9342			
MKTG	0.9342			
EDUCATEMPL		0.9085		
INTCONTACT			0.9065	
EXTCONTACT			0.8840	
R&D	0.9360			
R&D&IEMPL	0.8771			
R&D&IAGREEM	0.8716			
FIRMAGREEM	0.7033			
R&D&IINT	0.9531			
SIZE		0.9341		
YEARS				0.9347
ACCOUNT	0.7011			
PERMPEMPLOY		0.9457		

Kaiser-Meyer-Olkin Measure of Sampling Adequacy: 0.734. Sig.: .000

In a second step we used the critical KISA, variables pointed out by Component C_1 (CRITKISA) = f(V_{12}, V_{14}; V_{15}; V_{19}; V_{20}; V_{22}); α Cronbach = 0.823. These results point out that the most relevant variables associated with KISA (having the highest statistical weight) are brand development and marketing management, accountancy services, total R&D&I variables and R&D&I agreements. The effect of accountancy has been outlined in accordance with academic literature (OECD, 2006) while the effect of marketing and brand development

makes sense from the point of view of value chain upgrading (Humphrey and Schmitz, 2002). Finally, the effect of R&D&I variables is inherent to the innovation and knowledge intensity of the activity.

In order to expand our analysis of the effect of KISA we have applied a cluster analysis and regression exercises in order to justify the proposed model. A cluster analysis with this new variable (C_1) allowed the classification of the sample in three groups with 4, 36 and 82 members (Table 3).

Table 3. Number of cases in each cluster

	Number	Firms	Final Cluster (CRITKISA)
Cluster	1	4	18,10
Cluster	2	36	9,89
Cluster	3	82	2,07
Valid		122	

ANOVA for CRITKISA, F= 231,672 with p<0,0001

Table 4 below shows the mean differences for the value of different variables. It can be observed that variables such as PERFORM (V2, performance expressed as EBIDTA), EXP (V4, percentage of exports on turnover), PROFMANAG (V6, professional management separated from ownership), PERMPEMPLOY (V7, percentage of permanent workforce), EDUCATEDEMPL (V9, percentage of university educated staff), process innovative level (V1, PROCINN) and ASSOC (V23, being active in an industry association) have statistically significant different mean values. Moreover, those groups (number 1 and 2) with a higher CRITKISA values have higher positive replies for those variables. On the other hand, variables GROWTH (V3, employment growth in the last five years), SIZE (V5, number of employees) and YEARS (V11, firm age), the latter being control variables, do not reveal any statistical mean differences among all cluster groups.

Next, a correlation analysis was performed. This showed a significant correlation between CRITKISA and output variables such as process innovation level (V_1, PROCINN), firm performance (V_2, PERFORM) and level of export intensity (V_4, EXPORT). CRITKISA is correlated with absorptive capacity variables such as firms' permanent employment structure (V_7, PERMPEMPLOY) and level of staff education (V_9, EDUCATEDEMPL). No correlation appeared between CRITKISA and the control variable GROWTH (V_3) or the management profile, PROFMANAG (V_6).

Hence, the multivariate analysis has shown that outstanding KISA activities are: brand development and marketing management, accountancy services, R&D and innovative activities (internal) as well as R&D&I agreements (external). Networking activities are relevant as well as the variables connected with the absorptive capacity of the firms. KISA appear correlated with the variables reflecting process innovation, firms' performance, export intensity and absorptive capacity variables such as firms' permanent employment and staff education.

Finally, we proceeded to make a regression analysis and a discriminant analysis to identify which dependent variables, in particular, have a stronger influence on the dependent variables: V_2 (PERFORMANCE) V_4 (EXPORT) and V_1 (PROCESS INNOVATION). The results of the regression analysis shows that the independent variables: V_{14} (BRAND); V_{12} (ACCOUNT); V_{19} (R&D&I); V_{16} (FIRMAGREEM); and V_{17} (INTCONTACT) are related

with the dependent variable V_2 (PERFORMANCE). Moreover, the second regression analysis shows that the independent variables V_7 (PERMEMPLOY), V_{12} (ACCOUNT) and V_{19} (R&D&I) are connected with the dependent variable V_4 (EXPORT). The results of the discriminant analysis show how the following variables compose the canonical functions that discriminate the process innovation level of the firms. These are: V_7 (PERMEMPLOY); V_9 (EDUCATEMPL); and V_{16} (FIRMAGREEM).

Table 4. Mean differences between clusters for variables

		OUTPUT Variables				Absorptive Capacity Variables			Relational Variables	Control Variables	
Cluster	N	V_2, PERFORM	V_4, EXP	V_1, PROCINN	V_3, GROWTH	V_6, PROFMANAG	V_9, EDUCATEDEMPL	V_7, PERMPEMPLOY	V_{23}, ASSOC	V_5, SIZE	V_{11}, YEARS
1	4	4.0	65.5	1.5	2.0	1.0	16.0	51.8	1.0	80.5	20.5
2	36	4.2	58.0	1.2	1.9	0.7	10.0	52.0	0.8	65.1	24.8
3	82	1.7	19.7	0.9	1.4	0.9	8.9	26.1	0.3	63.9	34.0
sign	p	<0.001	<0.001	<0.001	n.s.	<0.05	<0.001	<0.05	<0.05	n.s.	n.s.

The empirical results show that the hypotheses proposed have been validated. H_1 which states that KISA activities have a relative influence on firms' innovative activities irrespectively of their technology orientation proves to be right in our case (low-tech manufacturing) as has been shown by cluster and regression analysis. H_2, proposing that KISA activities have a relative influence on firms' growth and economic performance has been partially validated since, though KISA appears correlated with EBIDTA, which is not the case of the growth variable. Finally, H_3, relating to the influence of firms' absorption capacity as a co-adjuvant in KISA influence has been also validated. KISA related variables, employees' education and staff stability, have an impact on innovation performance. Meanwhile, it has to be outlined that control variables such as firms' size (measured by number of employees) and years of operation are not significant. A third variable, staff growth, does not appear to be relevant either. This reinforces the idea that staff stability is the relevant dimension in this respect. It has finally been observed that most KISA are external, as could be expected from the average firm size of the sample.

4. Conclusions

The example discussed in this paper shows how KISA are relevant in low-tech sectors and mature industry where positioning in the value chain connotes improving firms' performance. Branding and marketing management, as well as distribution control by firms, help to upgrade their position in the value chain, thus reinforcing their competitiveness and performance. The research consequently links KISA to chain governance and opens up a new research alternative. Among the variety of KISA, brand development, marketing management, firm agreements, accountancy, internal R&D and innovation activities as well as external R&D&I have a higher statistical relevance in this research. In particular, a regression analysis showed that brand development, external accountancy activities, R&D and innovation activities, inter-firm formal agreements as well as local internal contacts (a cluster effect) are correlated with firms' performance measured as EBIDTA. Firms' performance measured as turnover export

percentage is connected with external accountancy activities, R&D and innovation activities and permanent staff.

A discriminant analysis used for identifying those variables with most weight in the firm's innovation level concluded with a canonical function composed by firms' formal agreements, permanent staff and level of education of employees. This function was able to predict the innovation level with 92.3% probability. The conclusion of the research was the relevance of KISA for firm innovation performance measured by firms' profits as well as export performance. An additional conclusion was the evidence of the impact of firms' absorption capacity as a coadjuvant to KISA effects. Since there was no previously published evidence, the contribution of the paper lies basically in explaining the role that KISA plays in innovation and, especially, in low-tech and mature sectors.

This fact has implications, in particular in the case of SMEs, for innovation policy and policy makers as regards recommendations to support KISA, especially those contributing to innovation. It could be pointed out as well that KISA is connected with issues of human capital and knowledge management. KISA is relevant in low-tech mature sectors where upgrading the firm's positioning in the value chain implies an improvement in the firm's performance. Externally provided services for KISA play a relevant role in the case of SMEs with restricted in-house resources. The role of industry associations in the sector consisting of SMES has to be considered as well. The research showed that KISA variables associated with this dimension are relevant. The clustering effect is also shown to have synergy with KISA adoption and impact. Finally, from a practitioner's view, the paper sheds light on the reasons involved in KISA adoption, on how KISA relate to firms' capabilities and on how these can be a barrier to KISA adoption but also may benefit from its effects.

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